DOCUMENT RESUME

ED 088 777 SO 007 237

AUTHOR Nathan, Henry
TITLE Stable Rules: Science and Social Transmission. Studies in the Learning Sciences.
INSTITUTION Organisation for Economic Cooperation and Development, Paris (France). Centre for Educational Research and Innovation.
PUB DATE 73
NOTE 59p.
AVAILABLE FROM OECD Publications Center, Suite 1207, 1750 Pennsylvania Ave., N. W., Washington, D. C. 20006 ($2.60)

EDRS PRICE MF-$0.75 HC Not Available from EDRS.
DESCRIPTORS *Acculturation; Audiolingual Skills; Cognitive Development; *Cognitive Processes; Communication (Thought Transfer); Cultural Factors; *Educational Anthropology; *Language Development; Language Patterns; Language Typology; *Learning; Mnemonics; Neurolinguistics; Perception; Psychoeducational Processes; Psychophysiology; Recall (Psychological); Socialization; Thought Processes
IDENTIFIERS *Social Transmission

ABSTRACT

In laying the groundwork for a co-operative scientific inquiry in the field of learning sciences the following five areas of access to the study are considered in this introductory inquiry statement: 1) genetic sociology (symbolic systems and early socialization); 2) experimental ethnography (the effect of literacy on the structure of skill and memory); 3) language and infancy (the child's contribution to linguistic change and stability); 4) ethnological studies (behavioural homologies); and 5) theoretical models of learning (artificial intelligence). Specific aspects of learning theory that are discussed include selection-recognition theories of learning; skills as the perception of differences and, as such, a basic feature of all cognitive processes; the "culture-specific" character of skills; the importance of phylogenetic studies; questions of stability in general; and the stable rules themselves. The exploratory nature of this introductory statement leads to the formulation of six areas readily available for further research. (JH)

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centre for educational research and innovation

STUDIES IN THE LEARNING SCIENCES

STABLE RULES: SCIENCE AND SOCIAL TRANSMISSION

OECD
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Centre for Educational Research and Innovation (CERI)

STUDIES IN THE LEARNING SCIENCES

STABLE RULES: SCIENCE AND SOCIAL TRANSMISSION

Henry NATHAN
Centre for Educational Research
and Innovation

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
1973

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2, rue André-Pascal, 75775 PARIS CEDEX 16, France.

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INTRODUCTION

The Centre for Educational Research and Innovation is exploring the possibility of a co-operative scientific programme in the field of the learning sciences.

The following text refers to five parts of the potential programme, each one concentrating on one or more components - human, phylogenetic, mechanical - of a general theory of learning. The strategy of the programme is to include ways of access to all five as recognised parts of a common field of study.

I. Genetic sociology : symbolic systems and early socialisation

II. Experimental ethnography : the effect of literacy on the structure of skill and memory

III. Language and infancy : the child's constribution to linguistic change and stability

IV. Ethological studies : behavioural homologies

V. Theoretical models of learning : artificial intelligence

Specific aspects which will be elaborated in more detail later are : selection-recognition theories of learning; skills as the perception of differences and as such a basic feature of all cognitive processes; the "culture-specific" character of skills; the importance of phylogenetic studies; questions of stability in general and the stable rules themselves.

The following document is therefore no more than a preliminary statement, the purpose of which is to provide a basis for discussion with interested scientific groups, and thereafter a programme of scientific co-operation in the field of learning theory.

June 1972

Two problems are better than one.
One of them may be the solution to
the other.

Skill, sb. ME /ā. ON. Skilja to
divide, distinguish, or skilja to
decide, related to Mdu. and MLG.
schillen and schelen to differ,
make a difference, etc.[7]

In short, the form of an object is
a "diagram of forces", in this sense,
at least, that from it we can judge of
or deduce the forces that are acting or
have acted upon it.

D'Arcy Thompson

Section I

COMMUNICATION

1. The burden of the arguments that follow - or at least the basis from which the other arguments may be inferred - is that there are two views of communication, one that we might call Lamarckian, the other Darwinian. The first says that communication consists in purveying a pre-existing message from a pre-existing A to a pre-existing B with as little interference as possible, so that ideally the process (noiseless and dirtless) will be perfectly reversible (that is, you cannot tell that anything is wrong when the film is run backwards). This view is Lamarckian in that the purpose of communication - or that form with which we are concerned, namely transmission between generations - is to preserve what has been acquired. The state of the art in the learning sciences, encompassing animal and human cognitive behaviour, is still at the stage where it accounts for the long neck of the giraffe by a phylogenetic adaptation to the height of food trees. The second view is Darwinian in that it does not consider transmission (always used here as between generations) as a means of preserving what has been acquired, but sees all acquisition (e.g. culture or language) as the result of vicarious selection favouring reproduction and recognition.

2. Two views of learning result : one, familiar to traditional learning theory, is that learning results from instruction (adaptation); for the other, selection (inhibition, amplification) is a more central feature.

Modern information theory is a mathematical language for talking about Lamarckian communication channels. The measure of information in this language is the actual amount by which uncertainty about output is reduced when a particular signal is received. In a "perfect" channel there will be complete one-to-one correspondence between input

and output signals. So observers will have the same uncertainty about both. We can see that the ideal model is symmetrical and reversible.

Furthermore, the input-output model has caused the role of inhibition to be underestimated (by regarding it as the simple inverse of stimulation). It is clear, for example, that when input equals output, information is conserved, communication is instrumental to other aims, a means of extending the message. The separation of language from thought, or the sterile debate on priority between them, results from a prosthetic notion of language use and a concentration on intention in behaviour in terms of which unintentional effects are considered error and noise.

3. This input-output model has made it difficult to see more than the isolated tasks that characterise psychological studies, centred as they have mainly been around experiments. In order to understand the above remarks it will be necessary to look at the origins of psychology and the function of experiments for, though there is no doubt that experiments are useful, indispensable, investigative tools, they are not neutral communication channels - though it seems often to have been assumed that they are.

Do we say what we mean or do we mean what we say ?

PSYCHOLOGY AND PHYSICS

Psychology is linked to the growth of the mathematical and physical sciences (the problem of the means of getting knowledge) as economics is to industrialisation. The relation is worth looking at in three ways :

1) A functional dependency exists between them, psychology patches up the discrepancy between sensory experience and the world discovered by mathematical physics.
2) Psychology provides scientific activity with its needed, exogenous, starting point, and provides support for the "objectivity" required in the programme of the physical sciences.
3) . The characteristics of the social sciences show similarities to those of the physical sciences in the early stages of their development.

4. We are only beginning to understand the mutual dependence inherent in the relation between the social and the physical sciences. The chief characteristic of the discovery of mathematical physics in the 17th century was that the world it proposed as real was describable only in mathematical terms, and was unrelated to the tangible world that we experience every day. This had never been suggested before by those who pretended to observe natural phenomena, though it had been, of course, by men who, though, had no engineering pretensions. Had this new science of physics not been successful, there would have been no serious consequences. But it was, overwhelmingly so, and left unexplained how man's senses, and apparently not only his senses, could lead him into error. It is this enormous question that provided psychology with its function, and it is to this question that psychology owes its origin. Since science of any sort is done by man, the problem of accounting for his innate and acquired errors is no trivial one.

The influence of Bacon on the development of sciences is due more to his observation on "idols" than on "scientific method". For what is new in the scientific spirit is not a belief that observation and experiment were indispensable to science, but a doubt about observation, a belief that lots and lots of experiments would be necessary and an insistence that all experiments and observations be reported in full and naturalistic detail, preferably accompanied by names and credentials of witnesses. Mediaeval scientists had believed that observation was indispensable, but they also believed the observations - they had no reason to mistrust their senses. The later developments go together with a growing mistrust of the human being as a reliable observer : an observation of a star is not a star observed but a clue to its position and no more. A certain ritualisation of observation sets in (that is, a showing of credentials).

5. Psychology is thus the propaedeutic science, concerned with accounting for or discounting man's performance as an observer, with perfecting the channel, a necessary adjunct to physics.

First of all, psychology as an effort at "objectivity" studies events as if outside time outside space, as if immediate in time and space. The experimental tradition in psychology and in physics is clinical-diagnostic, concerned with individuals and signs.

The physical instruments of the laboratory have frequently proved to be models for the world to be observed and for the concepts in terms of which hypotheses about the world are framed.

Properties of external "stimuli" with which psychologists have been concerned include those dependent on physico-chemical variables, such as brightness, loudness and colour, ecological properties dependent on association with noxious events or visceral gratification, and most recently, properties that result from the collation of elements of stimuli, such as novelty, difference and complexity. In each case, psychological investigation is an adjunct to the many models of scientific investigation, explanation, instruments of the physical sciences. Psychophysical properties are derived from distribution of energy, ecological properties from the factors governing natural selection, and most recent investigations attempt to reduce psychological phenomena to the terms of information processing.

IMPLICIT AND EXPLICIT KNOWLEDGE

6. Of course, both physical scientists and psychologists do experiments but that is due as much as anything else to a rivalry and emulation with which we are not concerned here. Certainly psychology - and the subsequent other sciences of man - has always aspired to the precision and transparency of mathematical physics, but its origins do not lie in that aspiration alone but in the fact that the programme of the physical sciences, particularly mathematical physics, was incomplete, and could not proceed without a psychology.

The similarity of experiments in physics and psychology lies in more than a supposedly borrowed methodology. Conversely there is a clinical atmosphere surrounding many of the historical experiments in physics. Psychology as propaedeutic to science : in scientific puzzle-solving, everyday thinking and the limit case studied by the psychologists, where the subject is under strain, coincide.

7. In emphasising how much of psychological thought has been rooted in experiments instead of in transmitted bodies of skill and knowledge, we are not so much concerned with pointing out the discontinuities between experiments and real life as with indicating to what kind of real life the experimental situations correspond and the possibility

of considering experiments not as a limit case of real life at all but as artefacts of induced verdicts. The induced strain of experiments produces verdicts.

Cognitive activity as observed under the perceptual strain induced by experimentation is a means toward a collection of verdicts abetted by instruments of various kinds : the senses, language, experience, and experiments. The experiments are typically such as to induce an illusory separation between "perception" and "cognition". The observed features of cognition and learning have in turn been attributed to a series of "faculties" designed for specific performances, the assumption being that each experimental task is diagnostic of a particular cognitive process. The concentration on the isolated task is reflected, in turn, to the point of absurdity, in the experimental tradition itself, both for the subject and his task and the experimenter and his.

8. The experimental tradition in psychology is tied to achieving conservation of information in the acts of observing and communicating that constitute psychological experiments. Hence :

1) the understanding of cognitive acts as immediate in time, and immediate (individual, clinical) in space; as reversible; as adequately reflected in experiments;
2) the assumed malleability of human beings as performers of tasks;
3) the tie of modern physical sciences and of psychology to an intentional explicit pedagogy in which tacit knowledge and skill are unaccounted for;
4) the difficulty of understanding the relationship between cognition and culture;
5) experiments take the form of isolated tasks diagnostic of particular cognitive processes, attributed in turn to a series of "faculties" designed for particular performances.

9. But what are these isolated tasks that constitute psychological experiments like ? What kind of experience is an experiment ?*

---

* In Piagetian Inventories (to appear), an attempt has been made to present the corpus of Piagetian experiments, stripped as much as possible of their intentional component. Though each experiment then appears as an error structure relatively free of its hypothetical purpose, the context provided by the rest of the corpus is strengthened.

And what characterises performance in them on the part of psychological subjects ? In what way, if any, do they exemplify the experience and the situation of the child or adult in learning, where relatively few tasks are well-formulated ? What kind of experience is an experiment ? Tasks may be defined in two ways :

1) explicitly (by instructions);
2) implicitly (by strain).

In either, the precision of the task and of the experience, its usefulness in investigating behaviour, requires that deviations in task performance be clear and classifiable. We are not interested in whether a subject performs the task well or not. The task must induce an error structure or behavioural maze in the population of subjects performing it.

The provenance of psychological experiments themselves makes it difficult to avoid inferences - invidious or relativist - about failure to perform (or errors, or poor performance) on the part of members of different cultures or subcultures. It is not enough to avoid inferring a lack of ability, as is often done. Some hypotheses are required about structures or strategies to which the errors correspond, and those hypotheses should be compatible with the transmission structure in which the cognitive activity takes place. The only experimental situations that can occur are those that fit these hypotheses. Of course, fitting a hypothesis is not the same as confirming it.

10. The point of the design of psychological experiment is to interfere with immediate recognition by straining habitual processes so that specific false responses become possible or a verdict is elicited. This means that the subject is forced to resort to criteria in order to perform. It is probably true of any isolated task that criteria are resorted to in the absence of context. In the presence of incongruity we search for cues. Criteria are always resorted to after-the-fact, or failing immediate recognition. Monitory attentiveness to criteria, or checks, are resorted to only when in doubt. There is a clear relation between these checks resorted to in the presence of doubt and the explicit methodical rules on which the whole of the scientific enterprise is based. Concepts are criteria for verdicts : ways of checking for cues, resorted to only when mechanisms that have been programmed for immediate recognition fail. In order to perform

ordinary unisolated tasks, a large amount of implicit, subliminal learning must take place. Errors are perhaps the only source of explicit knowledge we have.

11. The complexity of the process of visual perception of objects and of the representation of objects is well known. Investigations have shown that the apparent simplicity and directness of visual perception of an object or of its representation is often imaginary, for no sooner are the conditions of perception made slightly more difficult by blurring or by ambiguous signals or masking by other voices than the true complexity of the process becomes fully apparent. It is in such cases that it becomes clear that the recognition of objects is a complex activity, in part conditioned by education though not formal education. What people see is not necessarily the same as the verdict they give under difficult perceptual conditions.

Interference experiments may test the stability of the underlying competence (is it stable under minor perturbations ?) We will return to this possibility later.

12. Induced errors thus have several functions in psychological experiments. (It is important to note that only in the third role has error any invidious definition).

a) Product of induced strain : the purpose of the experiment is to isolate "errors" as unequivocally as possible. Ideally, the task is an error structure and all performances of the task are equally valid alternative articulations of the task.

b) Rules : the errors provide evidence of cognitive mechanisms at work underlying normal performance, of discrepancy between competence and performance, of a deep structure underlying the visible surface structure of behaviour (Section II). Fundamental processes are more clearly seen in errors than in confinement to norms. Errors reveal the mind at work as correct responses, adaptation, conditioning, do not, because we cannot be sure to what to attribute "correct" behaviour. For errors to arise, experience (experiment) is necessary. Yet experience without error is mute.

c) Trials : errors reveal steps in a progressive development from a given perspective provided by the task itself. They are a "heuristic", for reducing trial-and-error procedures

in the solving of the given problem. Note that "choice reduction" is an interpretation of how "discovery" (or "recovery") procedures such as grammars may be structured.
This last role is either a developmental version of the logical typology of alternative responses described under (a) or it reflects a view of the tasks as steps in a successive surrender of nature's secrets to sound methods skilfully deployed.

13. What results when cognitive processes and theories about them are extrapolated from the observation of isolated, reconstructed tasks, where the subliminal component of the task (which includes its context among other things) is excluded ?

The point here is not that experiments are partial or special cases, but that they are a part of a collection whose content is thought to be reproducible by the concepts to which the subject resorts when at a loss. But the corpus of skill and knowledge is probably not so reproducible.

A psychology that asks only questions concerning methods and concepts, and that views learning as an accumulation of independent units, will get not further than scientific textbooks, based as these are on the idea that a body of knowledge and skill can be reproduced methodically (explicitly).

Thinking is usually described as a new combination of previously learned elements among which problem-solving situations have been predominant. Cognitive development must then necessarily be understood as some form of "learning to learn". The purpose of cognition will then be - in other words - "deuteronic" : to reduce the need for more cognition. This is a device, or law, of "least effort" and "least uncertainty" that resembles planning. It is clear that tasks and rules already contain a great deal of structure, resemble, in fact, the struc structure contained in the language by which children acquire a great deal more than linguistic skill. A great deal of information about the economics of cognitive organisation can be had from an examination of its tools. The most potent tools are what is thought about, what is remembered, what is learned.

When we memorise a sentence, all our previous familiarity with the lexicon and grammar of the language comes to our aid. Rehearsal

or repetition has the effect of organising many separate items into a single unit like the substitution of a single symbol for a longer expression that is the operation used in multiplication. Men form complex ideas, as Locke said, "for the convenience of communication". But the process sometimes leads to confusion because it is the "workmanship of the mind and not referred to the real existence of things". Cognitive skills do not develop by themselves, nor is memory separable from what is remembered, which in the case of linguistic items contains its own mnemonic devices and selects and develops in the learner those skills and strategies that are most propitious.

One can imagine a theory of cognition that is not, as present theories are, completely dependent on experiments both as a source for hypotheses and as evidence. "What is learned" can be studied :

a) by studying the product, by an analysis of the explicit intended body of knowledge, skill, belief;
b) by studying the process of acquisition independent of the product, which means studying the acquisition of a very small part of the product and assuming that the rest is just more of the same;
c) by studying the errors induced by acquiring a <u>specific</u> product : the minimal processes essential to acquiring the specific product - and <u>maintaining</u> it.

14. This discussion suggests that conduct observed in isolated tasks is detached from its implicit psychological context by the very design of the experiment, and that the purpose of these experiments is to induce criterial attentiveness and decisions of a <u>skilful</u> nature. In other words, alleged cognitive processes are not being observed at all, and learning as it has been understood is an experimental fiction. Furthermore, the provenance of psychological experiments is inimical to their use in understanding the relation of cognition to culture, for these experiments are propaedeutic artefacts of procedures in the physical sciences. The "experimenter effect" is the following : the experiment is derived from a corpus of mechanisms and procedures, and from a view of these procedures and mechanisms that abstracts them from their tacit subliminal, skill, craft, context. A physics that requires a psychology to expunge "experimenter effects", or noise due to the observer, that requires its "stimuli" (input) and

"sensations" (output) to correspond perfectly, requires in turn a psychology based on an assumption of human malleability and uniformity. Differentiation or recalcitrance in behaviour, or even species-specific behaviour, cannot be taken seriously.

COGNITION AND CULTURE

How does the culture in which someone is brought up affect the development of thinking and learning ? Are the abilities to think and learn different in cultural and racial groups ? We will suggest in the coming sections that these questions are not well put, that they beg the questions they ask.

Concentration on isolated tasks makes it difficult and probably impossible to treat cognition and culture together. The associated concentration on a supposed "immediacy" of perceptual acts also obscures the cultural component since apparent immediacy in recognition of objects and their classification is precisely what members of a culture share and what a culture or a language achieves and maintains in its members : it does not underlie cultures but is a cultural product. Members of the same group, culture or species recognise the same things as the same. That is one of the meanings of winking : do you see what I see ?

15. What chiefly characterises members of the same culture, subculture, or group, what a culture "teaches" its members, is the immediate recognition of the same things as the same. What is regarded as <u>self-evident</u> is the result of training. The products, arts, kinship and disease classifications and rituals are buttresses and by-products of this transmission. What require study are the mechanisms by which the shared intuitions and meaning of its members -whether they be the immediate recognition of forms or well-formed sentences, whether they induce linguistic or perceptual uniformity - are transmitted. Otherwise you are asking what "culture" is, as if there could be nothing.

16. On the other hand, the scientific claim is that a "universal", other-than-cultural, transmission can be substituted for the cultural one by an incorporation of knowledge that acts to increase unanimity and univocity. The scientific claim is that, at least in theory, any body of knowledge or skill can be reconstructed by explicit rules,

axioms, instructions, receipts such as can be perfectly and unambiguously transmitted.

The distinction between "learning by doing" and school learning and between formal and informal learning hinges on the transition to school - on the part of individuals and groups - as a transition from oral to written transmission. Written instruction, the context which we know as "pedagogy", transmits intentional knowledge and has no explicit understanding of the unintended component. In this context, "cognitive" means an intentional process. Research is the search for knowledge turned into a form of work. Writing, similarly, is reading (or browsing) become industrious. Yet theory and practice alike separate sender from receiver, writing from reading, teaching from learning, speaker from listener. A separate sender and receiver is indispensable to giving the character of communication to all human events. The separation of teaching from learning (in every level), and of writing from reading, accentuates the instrumental role of one and the docility of the other. What this means above all is a claim that a "universal" other-than-cultural transmission can be substituted for the cultural one, by an incorporation of knowledge that acts to increase unanimity and univocity.

We are becoming increasingly aware that this claim does not hold up in practice; that skill, craft, implicit, tacit knowledge, are a large component of scientific practice; but we are at a loss to understand this component. At least in theory, scientific practice attempts to incorporate its knowledge in such a way as to be independent to a high degree of the vagaries of human and circumstantial differences, and on the components of what we recognise as cultural "traits" and "characteristics". The "scientific" study of "culture" and of other human products has been at a loss to deal with just those phenomena that scientific practice claims to be able to replace.

17. Theories of learning and cognition have been particularly unfit for cross-cultural questions. The function of schools as secular acculturation agents permitted education to be regarded as an instance of some autonomous, context-free learning process. The attempt to infer underlying ability from performance implies a diagnostic notion of competence (you have it or you don't) yet there is no reason to assume that cultural differences are symptoms. Asking what is common

to all cultures is like asking what is common to animal species. It is that they differ.

We have tried to suggest how psychology has been tied to the investigation of the performance of isolated tasks, isolated from their context and hence neutral with respect to any context. These tasks, lodged in experiments, may take place interchangedly in any isolated place : a psychological laboratory, a classroom, a workplace, or a medical clinic. The patient, worker, student, are constant points of reference. A member of another culture, an aboriginal, is similarly buttonholed. But of course studies of cognition and culture are either basic to cognitive studies or they are not. They are not another application of what we already know. After all, our own culture is not culturally neutral, except insofar as we think a radically different, explicit, transmission is possible.

The transition to a written "memory store" brings with it a transformation of what is considered knowledge and of the cognitive processes that serve.

Along with schooling comes - on the part of individuals and peoples alike - the transition to writing : decontextualised, intentional, explicit transmission. With the change in the mode of transmission comes a depreciation of oral transmission and the skills that the new knowledge is designed to replace by a form of cognition that is increasingly methodical, specialised, work. This is a cognitive effect that coincides with the school's traditional acculturating mission and persists when the mission changes.

Just as all communication systems of language users (which all imply the underlying role of language) differ substantially from any communication system employed by speechless creatures, so the speech of peoples who possess writing differs from the speech of those who do not and is dominated by the written mode even where little or no writing is actually done. Thus in present day Africa, cultural gulfs are less between generations than between literate and non-literate, each cut off from access to the culture of the other.

18. There was little pressure to make doctrines relevant to the problems on which they pronounce as long as the doctrines were acceptable, as long as they coincided with the school's mission as it was widely understood. Psychology, like economics, has had a tendency to take as data for analysis precisely what must be one of the outcomes

of an analysis that is more than an apology for existing institutions. Robinson Crusoe, the allegedly autonomous "economic man", was heart and soul a shopkeeper.

19. Recent years have, in fact, seen the revival of so-called "genetic" theories to explain the pattern of racial and social class inequalities (Jensen, C. Burtt, chiefly). Proponents have restricted their considerations to the narrow questions of the "heritability" of intelligence as measured by I.Q. tests.

Opponents of these hypotheses contend that I.Q. tests in fact measure scholastic achievement and that test scores may be accounted for by socio-cultural influences. Thus, both sides assume I.Q. tests - and success in school - to be a measure of the "cognitive ability" required for economic success in present-day society, though one side considers the ability "innate" and the other considers it "acquired".

The arguments are inadequate for two additional reasons. First, scientists have become so used to thinking of evolution in terms not of individuals but of whole populations, not of genes but of genes pools, that they would hardly be tempted to ask questions of studies of individuals for answers to the heredity versus environment problem. They ask the question : does the environment of a parental population affect the heredity of its offspring population ? And of course it obviously does, by leading to the selection of suitable individual parents to leave more offspring than others. We are not interested in whether environment affects performance, but whether it affects genes. Twin-studies, since twins have the same genes, are therefore completely irrelevant. Jensen's evidence is from studies of populations; the evidence to the contrary presented by him as well as his opponents consists generally of studies of individuals (like twin-studies) and so proves nothing. To the extent that Jensen is right, he presents the strongest evidence yet gathered for the social injustice suffered by disadvantaged populations.

20. A parallel may be seen between the unequal access of groups and subcultures to the explicit uniform measures of education (unequal "ability to learn") on the one hand and their unequal access to public measures generally - economic,-social, or medial. Disease is like an experiment made by nature in which a factor is modified or eliminated. Public measures including education also can be seen as

social experiments in which variables are changed with unknown and unintended consequences. All assume that an explicit, non-cultural transmission is possible, all assume a very large degree of malleability, that explicit methods and rules are sufficient to reconstruct bodies of knowledge and belief, that explicit plans are sufficient to reconstruct a society.

DISCONTINUITY AND TRANSMISSION

> "L'enfant qui apprend à parler ne reçoit pas la langue toute faite : il doit la recréer tout entière à son usage d'après ce qu'il entend autour de lui." (Meillet, 1929)

21. What most characterises learning is its <u>discontinuity</u> between the learner as receiver and as sender, the large subliminal content that forces us to ask first of all not <u>what learning is</u>, but <u>what is learned</u>.

The clear discontinuity between what the child or adult understands and what he or she says is typical of all human behaviour and underlies much work in recent linguistics (see Section II). The grammar of his own spoken language and the grammar of the language he hears are often in conflict. The obvious though as yet unanalysed discontinuity between the receiver's and sender's code makes untenable any view of communication as simply a conservation of information, an equivalence of input and output, between sender and receiver, even when the two are distinct persons.

The fact that transmission is largely subliminal, and that the "tacit" component is larger than the explicit one, makes possible the efficacy of the learning process as a process of social control. Learning is a <u>dependency</u> on transmission. This fact makes any sharp distinction between cognitive and non-cognitive activity difficult to make for adults, and impossible to apply to young children.

It also makes it difficult to distinguish completely intended from unintended effects. Strong evidence for the considerable role of unintended effects in informational and experimental circuits is beginning to be taken seriously. The role of experimental bias in behavioural research with both animal and human subjects is made all

the harder to explain if a sharp functional distinction between explicit and tacit knowledge is maintained and tacit implicit knowledge is regarded for better or worse as somehow extrasensory - a "sixth" sense.

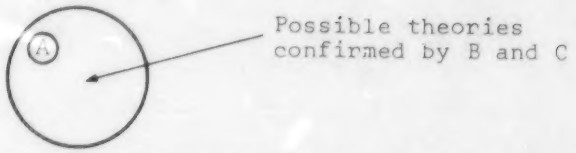
22. And finally, the structure of skill, and all the practices, techniques, arts related to it, has been an obscured area of psychological study, considered irrational, pre-scientific, intractable. It is only recently that the ties between modern physical science and the earlier craft traditions have come to be appreciated as matters of historical fact, a development that is bound to cause more attention to be paid to implicit, tacit knowledge in scientific practice.

23. When one considers the role of traditional psychology in progressively eliminating certain types of experimenter effects relating to observation in the physical sciences, it is well to remember that in behavioural experiments the instruments are only partly observational, and there is a large communicational component. Most recently physics has had to face the fact, clear on the quantum level but surely general, that, as Bohr liked to say, observation is an irreversible process. It is possible that the emphasis on explicit knowledge, itself part of the programme of modern physical science, is gravely misleading for sciences dealing with behaviour, where intentions in fact obtrude on a field of unintended effects already well ensconced, constantly active, orderly, and ever "lawful". Obviously, most effects are unintended, most understanding is tacit, most communication is subliminal, most knowledge is skill.

In recent years, increasing attention has been paid to the effects of expectancy and other experimenter effects in behavioural research - which differ from experimenter effects in physical science research in that they are reflexive, and observation and communication become lost in each other, producing an effect similar to solipsism. If these effects are assumed to be rare then they are only an obstacle to the reduction of error in the study of behaviour. But their rarity is an illusion.

24. Hume called attention to the scandal of induction which can be expressed by noting that science makes use of an invalid logical argument (but not a useless logical argument) of the following form :

If A then B and C should be observed
B abd C are observed, hence
A is confirmed.



Experiments verify either indeterminately more, or less, than the hypotheses they are supposed to test. The subliminal content of experiments is in fact enormous, both in physical and behavioural research. It is for this and other reasons discussed above that experiments are inevitably pedagogic in their effect. The residual experimenter, or experimentee, effect lies perhaps in neither one nor the other - not in the channel - but in the message and code. Furthermore, isolated tasks obscure the discontinuities in the transmission of all skills, so that it becomes impossible to ascertain what is learned, let alone that something is learned.

25. Leaving aside the special case of experiments, and speaking more generally of any learning situation : what is learned ? Clearly not what is transmitted as signal. Processes of a highly abstract sort "infer" or extrapolate from what is transmitted as signal and from it reconstitute a far greater field. It is obvious from the observation of child language learning that much more takes place in the growth of a child's abilities than can be accounted for in the intentionally transmitted signals, or in what the child sees and overhears. "Experience" does not account for "knowledge".

26. The best indication that we do not know what learning is is that we do not know what is learned. The child hears a sentence, receives a message, but at the same time is learning a language. A regulative effect is derived from this discrepancy between intended transmission and subliminal learning. The formation of character and the acquisition of "personality" traits are consequences of the performance, or failure to perform, of any task including learning (cf. Luria's work on the directive function of speech and Bernstein's work on codes).

27. When a child "interiorises" speech, it is not the particular item or directive that performs the directive function. With it, he

interiorises all the properties and features which linguists try to study. The child takes in more than the instrumental intention, or rather is induced to focus on the instrumental function or intention, at the expense of others that continue to act.

The discontinuity between intentional or explicit and subliminal transmission underlies the non-sensory or "directive" factors in perception. The perspective effect of a stimulus is dependent on the expectancy of the organism as a whole. The organism is in a state of expectancy about the environment, has come to depend on constancy in the environment. For this reason, we might suspect that behaviour with regard to "first-cue" searching when faced with an unfamiliar situation or unrecognisable object might be particularly related to the cultural component in behaviour.

28. It is likely that the whole relation between culture and behaviour needs reformulation. A great deal of work is needed in supplementing psychological experiments by ethnographic techniques for studying thinking in the context of bodies of skill, knowledge and belief. As yet, there is a wide gulf between psychological approaches to cognition and as yet undeveloped ethnographic techniques. At present, the best we can do is discern what we assume are underlying universal capacities at work in different tasks characteristic of groups under investigation. That view is in accord with a view of thinking as a new combination of previously learned elements. It is also a view that facilitates the division of labour. The learned elements can be combined according to objectives quite alien to the situation in which they were taught.

Section II

LEARNING AND LANGUAGE

29. Language presents s special problem in the study of learning. The infant cannot begin to talk without any contact with speakers, but as soon as such contact is established then whatever the environmental language is, the child will acquire it (provided he has not passed his seventh year),whereas any further language can be learned during adolescence or maturity. This puzzling fact and the universality of language among humans and only among them call for an inquiry into its phylogenetic prerequisites. Linguistics intervenes between biology on the one hand and ethnology, sociology and psychology on the other.

Problems raised by the organisation of language are characteristic of almost all other cerebral activity. There is a great advantage in studying the acquisition of these structures by children. The study of language, as opposed to other cognitive skills that one might attempt to distinguish from language competence, has the considerable advantage that its subject matter is a controllable body of knowledge, (clearly differentiated from other languages, for example). It is also a clear example of an orally transmitted skill. Furthermore, scientific description of verbal behaviour is far advanced over that of any other behavioural description and provides a suggestion of what other theories of behaviour might look like. This does not mean that cognitive and linguistic processes as such are identical. But it does suggest that there is a single substratum, and that the frequent priority controversies about thought and language have been beside the point.

30. The ability to master a language like a native, which children possess to an extraordinary degree, is almost completely lacking in the adult, due to deterioration or loss in the adult of the ability

to elaborate and extrapolate on the basis of a restricted corpus of examples ("pour chaque individu, le langage est ainsi une recréation totale faite sous l'influence du milieu qui l'entoure" - Meillet (1929).

It is not necessary that the child and his parents have the same grammars constructed by induction from the utterances to which he has been exposed, for a given set of utterances can be generated by more than one grammar.

31. The discrepancy between what children (and not only children) understand and what they do can be demonstrated, as has been pointed out, more clearly in language than elsewhere. This is probably due chiefly to the evident lack of correspondence between the form of linguistic utterances and their functions : some very analogous or contiguous functions have very different expressions and some very different functions have analogous or contiguous expressions. In learning a new language it is this sort of information that is most needed and least provided by dictionaries. So the suspicion that there is some underlying logic is likely to arise. Ambiguities arise from the point of view of the receiver who monitors expressions as they arrive. What dictionaries do not supply are tacit understandings and associations agreed upon; in other words, the role of the communication code and channel on the signal and message.

32. How are the explicit and subliminal components of transmission connected ? Some inference process goes on, by which - as in the case of language - the child understands and says far more than he can ever have heard. And it is also likely that a mediating process goes on which necessitates that, as in the case of stimulus and sensation, the two components are different, and "arbitrarily" related. We now turn to these two possibilities. In the following pages we will look first at what an analysis of a corpus (in this case a language) can contribute to an understanding of what the child learns when he learns his native language, and then in Section III we look to the stimulus-sensation nexus for possible mediating processes that underlie immediate "first-cue"-searching in perception.

The two possibilities are methodologically related. For no method has been found whereby the vitally important process of learning general principles from fragmentary indications can be made to function effectively.

33. Recent research increasingly avoids descriptions formulated in terms of function until enough of the structure of relevant behaviour has been revealed for it to be possible to assess what are the end states and consequences. Thus it has been plain that one part of behaviour, a single act, a recognisable signal or a custom, can have more than one function and that parts of behaviour at present regarded for functional reasons as separate are seen through the examination of their structure to have significant interactions.

34. For example, when a particular factor is incapacitated by a brain lesion, all the complex behaviour processes that involve the factor are disturbed and all others remain normal. Sorting out the various factors, we find that behavioural processes that seem very similar or even identical may not be related to one another at all. On the other hand, behavioural processes that seem to have nothing in common may actually be related.

Similarly, it is idle to speculate about laws of learning until there is more understanding of constraints on potential knowledge. What appears linked in what is learned often is not, and transfer often occurs between disparate skills.

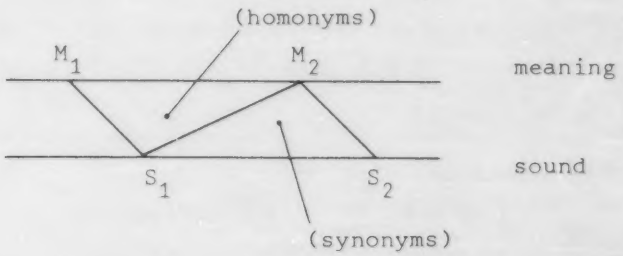
35. To illustrate what is involved, we will describe the difference between the two known(possible ?) kinds of computer : analog (or logarithmic) and digital (or algorithmic). In the language of computing machines, analog and digital computers differ in the kind of correspondence between input and output.

In the analog machine, continuous variation in the input to the machine will result in a correspondingly continuous variation in the machine's workings and in its output (hence it is a logarithmic machine).

In the digital machine, no simple resemblance exists between the input and the processes in the machine, or necessarily its output (hence it is an algorithmic machine).

36. The two machines differ as between continuous and discrete processes, and as between the use of first and second signals - directly perceived stimuli and delayed responses. The serialisation essential to language - the projection of meaning into a sequence - requires the separation of form and function (of input and output

- that we will call "digitalisation"). "Digitalisation" is characteristic of mediation in general and suggests a distinction between two operative structures, "deep" and "surface". If meaning is structure A and sound structure B, then the fact that there are homonyms (same sound, different meanings) and synonyms (different sounds, same meaning) suggests a semantic topography between these extremes. This suggests a means for studying early semantic development (how is the sound-meaning nexus organised and developed ?) by a study of the semantic space of a given word as what is not denoted by another word. An ingenious experimental method that is applicable to this study has been suggested by A.R. Luria. Further applications should be made to B. Bernstein's studies of semantic organisation in the speech of different social classes.



There is a similar disjunction between :

function	-	structure
stimulus	-	sensation
receiver	-	sender
genotype	-	phenotype
competence	-	performance

In the next section we will see that this digitalisation also pertains to the stimulus-sensation nexus.

CHILDREN AND LINGUISTS

37. The capacity to learn from fragmentary evidences also applies to theories about cognition and learning, and recent work has identified processes and theories about those processes to the extent of treating knowledge how as if it were the mere implementation of an underlying knowledge that ("Formally speaking, acquisition of 'common-sense knowledge' - knowledge of a language for example - is not unlike theory construction of the most abstract sort" - Chomsky).

The child is thus father to the man : a precocious linguist. The "knowledge" of the speaker is identified with that of a linguist who sets himself the task of finding a linguistic description of all and only those sentences that native speakers of a language feel are potentially grammatical - whether they have ever heard them or not.

38. The central idea in Chomskian linguistics was first developed for combinatorial systems in the study of formal logic (E. Post, 1936). Starting from a basic axiom, we apply rules of formation that permit us to rewrite the axiom in certain acceptable ways until we have finally derived the desired sentence. If the rules are properly formulated, only grammatical sentences will be derived. Underivable sentences will be ungrammatical.

Notice that in formal logic such systems were developed precisely to make up for the unreliability of intuition, as a test of consistency of a purely formal system. In Chomskian linguistics, the intuition of native speakers is both the source of data and of evidence with which to test hypotheses. Yet it is by no means certain that the most economical and efficient formal description of linguistic data will necessarily describe the process involved when we actually produce or understand a grammatical sentence.

39. If we think of cognition as a form of information processing, then its purpose appears to be the reduction of the need for further cognition. That looks like planning. The search for a psychological substrate (or "reality") of a plan may well be as futile or indeterminable as the search for a psychological "reality" of any given formal grammar.

We construct grammars in order to rule out constructions : usage that is felt to be acceptable is that which does not "break" any of the rules, not that which obeys the rules. This suggests that what is involved in judgments of non-acceptability is akin to the recognition of dissonance in music. Furthermore, this intuition as to what phrase patterns may or may not be acceptable is as much "performance" as the understanding or production of speech.

40. What is learned in cognitive matters including language may be called "competence". It certainly is not likely to be what is taught. It may be assumed that in all cases the learner's achievement in systemising data goes far beyond his actual skill "performance". The range of competence is much greater than the range of performance.

The distinction between competence (deep structure) and performance (surface structure) does not derive from the distinction between what a child understands and what he says or does - competence is not potential performance. The need to postulate derives from the disjunction between form and function that underlies the differentiated organisation of all existing languages.

> "By a 'generative grammar' I mean a description of the tacit competence of the speaker-hearer that underlies his actual performance in production and perception (understanding) of speech. A generative grammar, ideally, specifies a pairing of phonetic and semantic representations over an infinite range; it thus constitutes a hypothesis as to how the speaker-hearer interprets utterances, abstracting away from many factors that interweave with tacit competence to determine actual performance." - Chomsky, 1965.

41. The problem for the investigator is to discover what constitutes unconscious latent knowledge - to bring to light the speaker's "linguistic competence". This organising power gives the speaker the ability to make new sentences which he has never used before and to understand sentences he has never heard before. Grammar is then an algorithm with which to decide whether a sentence is well-formed, that is which can substitute for the intuitive judgement of native speakers.

In considering these skills, we may try to discover logical structures involved in competence, or give a pragmatic model accounting for performance. The difference is not quite reducible to that between knowing and doing, but it is a like-minded dilemma.

Questions as to performance ask : "how do they do what they do ?"
Questions as to competence ask : "what are they doing ?"

42. If cognition is the following of "rules" then a new set of rules is required for implementing these rules, and still others for this second set of rules and so forth. Nor can general psychological perceptual strategies alone account for linguistic knowledge, for perceptual skills are as complex and abstract and problematic as linguistic skills. Highly abstract and specific principles of organisation are characteristics shared by perception as well as the production of sentences.

Much of this and the next section is in the spirit of Lashley, who will serve as transition :

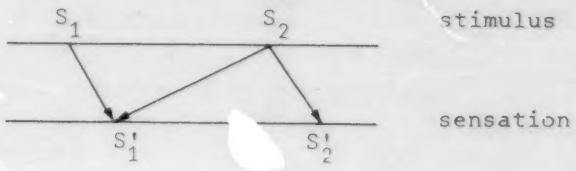
> "I have devoted so much time to discussion of the problem of syntax not only because language is one of the most important products of human cerebral action, but also because the problems raised by the organisation of language seem to me to be characteristic of almost all other cerebral activity. There is a series of hierarchies of organisation; the order of vocal movements in pronouncing a word, the order of words in the sentence, the order of sentences in the paragraph, the rational order of paragraphs in a discourse. Not only speech, but all skilled acts seem to involve the same problems of serial ordering, even down to the temporal co-ordination of muscular contractions in such a movement as reaching and grasping. Analysis of the nervous mechanisms underlying order in the more primitive acts may contribute ultimately to the solution even of physiology of logic." (Lashley, 1951)

Section III

PERCEPTION AND COGNITION : MEDIATION

43. What is built into the neural process that transforms stimuli to sensations has been transmitted through training. Therefore in an experiment that strains this process, it is still not possible to have just any perceptions at all. And any perceptual ambiguity or incongruity is likely to fluctuate in an orderly way that relates to a sequence of acquisition, much as does the dissolution of any motor skill.

The correlation of stimulus to sensation is neither one-to-one nor independent of learning. In fact, a psychophysical law - that is a law relating stimulus to sensation - presents the same type of rebus transformation as that relating deep and surface structure, or competence and performance,



that is : two different stimuli may produce the same sensation, and a single stimulus may produce two or more different sensations.

Neurophysiological studies and comparative phylogenetic studies of the development of these correlative systems in biological evolution are motivated by

1) the search for psycho-physical correlations (for example one might say (S.S. Stevens) that equal stimulus ratios produce equal subjective ratios, though we are not saying

that here. The following remarks are indicative of the main lines of our argument for which a vast supporting literature exists. They are enough for the purposes of the rest of the paper); and

2) by a view of cognitive and perceptual processes as continuous in kind.

44. The first remark concerning a psychophysical correlation is that it is not a continuous correlation, but highly selective, and susceptible to education. We shall argue that a great deal of information loss goes on and that the sensory receptors act as amplifiers of a small part of the physical stimulus.

Earlier behavioural theories presented organisms as passive recipients of experience and saw as a primary goal the task of exploring why an organism behaves. Neurophysiological discoveries have caused us to change fundamentally our conception of the organism as that of an actor and to ask why some "responses" are selected and others not. Inhibition and selection become central questions.

45. Attentiveness is skilful. What are the mechanisms that determine whether or not a given stimulus is perceived ? People do not see stimuli.(Our knowledge of stimuli is highly theoretical and abstract.) Instead, they have sensations, and we cannot suppose that the sensations of two viewers are the same. Even the common form of colour-blindness - red confused with green-was noticed for the first time in 1795 by the chemist Dalton, who discovered that he could not distinguish certain substances by their colours although other people could do so without difficulty.

46. Very different stimuli can produce the same sensation. Land's work on colour perception clearly shows the dangers of losing phenomena through simplifying situations in order to get neat experiments :

Photographic negatives of the same scenes, each made through different colour filters, are converted into positive transparencies and projected through their original filters to give superimposed pictures on the screen. Quite good results are obtained (green and other colours not physically present) simply with a red filter for one projector and no filter for the other. Consider an ordinary colour film transparency : it is no more than a complex spatial arrangement of three colour filters, and yet it gives us brown and metallic hues

unobtainable experimentally by superposition of three colour filters. It seems that when the three lights are arrayed in complex patterns with many boundaries, and especially when they represent objects, colours are more varied and clear.

The characteristics of the stimulus are secondary in determining what is perceived. Energy considerations are paramount in Darwinian selection. A species senses no more than it must for survival. Futhermore, perception in gregarious animals must withstand the test of group use.

47. The task in any given study of perceptual equivalence ("that is a triangle, and so is this") is to determine by reduction methods what particular stimulus attributes are critical for identification of an object as belonging to a certain class or, more simply, as being a certain thing. Formally speaking, the determination of the critical attributes of an equivalence class is the same whether one is at the perceptual level or at the level of providing the defining properties of such an abstract concept as "force" and "momentum". This suggests that the equivalence classes, the mechanisms for concept attainment which underlie much of scientific activity, may be described in terms of perceptual theory.

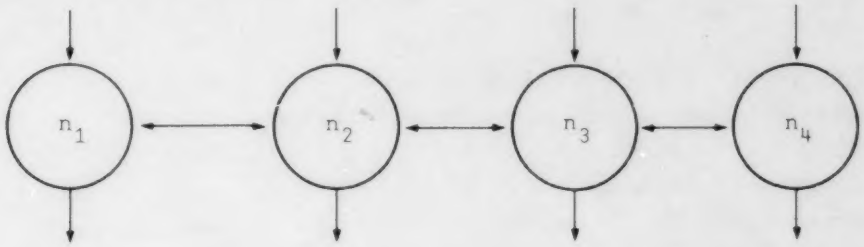
48. In perception, the reactivity of receptor cells is "gated" by the state of stimulation of neighbouring cells. Thus if retinal cells A, B and C lie next to each other in that order in a row, stimulation of B suppresses or inhibits the sensitivity of C. If now A be stimulated, B is inhibited and C is released or heightened in sensitivity.

49. The interplay of excitatory and inhibitory influences over interconnections within sensory organs yields patterns of nerve activity that are other than direct copies of the pattern of external stimulation. Certain information is selected from the immense detail in the temporal pattern of stimulation on the receptor mosaic, enhanced at the expense of other information and only then transmitted by the central nervous system.

Among the most significant features of a pattern of stimulation are the loci of transitions from one intensity to another and from one quality (colour, for example) to another. Indeed, if only these contours are represented - as in a line drawing - much of the significant information required for recognition is retained. The neural

mechanism plays a role in detecting and enhancing such contours. Telephone engineers know how little information is actually required to permit a voice to be recognised.

Inhibitory interaction among neural elements is a fundamental neural mechanism common to many sense modalities, integrative levels and species, and its principal functional properties appear to be much the same wherever it is found.



50. The discharge of impulses in any one nerve fibre depends not only upon the stimulus to the specific receptor unit from which that fibre arises but also upon the spatial and temporal distribution of the stimulation of the entire population of interacting elements. These interactions accentuate contrast at sharp spatial and temporal gradients and discontinuities : borders and contours become "crisp" in their neural representation. Certain information of significance to the organism is accentuated at the expense of less important other information.

Inhibitory influences are exerted mutually among interacting receptors. The activity of each is the resultant of the stimulus to it and the inhibition or excitation exerted on it by the others. Under steady stimulation, the inhibition exerted by one receptor unit on a second receptor unit in its neighbourhood is a linear function of the frequency of discharge of the first receptor unit. The interaction between two receptors is normally stronger the closer they are to one another in the receptor mosaic. This fact has an effect on patterns of nerve activity : elicited by various configurations, contrast is accentuated in the vicinity of steep gradients. The transient dynamic phases of the inhibitory interaction accentuate the nerve response to temporal changes as well.

Contrast effects, for example, may be expected to be greatest at or near the boundary between a dimly illuminated region and a brightly illuminated region of the retina. A unit within the dimly lit region, but near this boundary, will be inhibited not only by dimly illuminated neighbours but also by brightly illuminated ones. The total inhibition exerted on the unit will be greater than that on any other dimly lit elements further from the boundary. Similarly, a unit within but near the boundary of the brightly illuminated field will have a higher frequency of discharge than other equally lit units located well within the bright field but subject to stronger inhibition since their immediate neighbours are also brightly illuminated.

The role of inhibitory interaction in generating specialised neural responses to temporal changes in stimulation may be of greater physiological significance than the part it plays in enhancing contrast under steady-state conditions.

52. This is, of course, also the way in which all organs of perception, including the ear - where stimuli are primarily temporal - act as differential amplifiers. We can recognise a tune whether the pitch is high or low, a triangle or a letter whatever its size or whatever the position of the image on the retina. This must mean that there is no need for particular sensory endings or particular pathways to the cortex to be excited. What needs explaining is how certain properties come to be the "defining" properties of a class and others irrelevant. Both defining and perceiving, but especially the latter, are done under the pressure of loss of information, and the criteria must suffice under maximum uncertainty. Psychological experiments in perception consist in selectively inducing this uncertainty.

The relation of signal to response is a consequence of differentiation among signals. This differentiation makes possible the serial integration common to verbal and motor activity and in general the mapping between space and time that is characteristic of both : the role of expectancy in the reception of sentences in time; the role of speech in making plans and carrying them out.

53. The integrative scanning involved in mapping signals between time (sequence) and space (simultaneous) is common to receptors in

sight, hearing, touch. Spatial stimulation must be transformed into temporal stimulation in order to be received. If an image is kept at a constant point on the retina , which can be done by optical attachment on the cornea, the image disappears within six seconds. If the image changes position even slightly on the retina, it is again seen. So it seems that part of the function of the saccadic eye movements is to sweep the image over the receptors. Change over time is necessary even for the maintenance of a simple image.

54. Difficulties in auditory reception correspond inversely to the distribution of distinctive phonological features in the language. The ability to select out of the complex auditory input those features that are phonologically relevant corresponds to the phonological organisation of the language itself.

What matters in each language is not the isolated sounds in the repertoire, but the distinctions between sounds, the relation between each sound and all the other sounds in the system. The repertoire of these distinctions governs the sounds and reduces their range and contiguity. The majority of sounds is (suddenly ?) lost in the transition to language on the part of the child (corresponding to the differentiation of his particular language) when sounds acquire a phonemic function, that is, a function as sign.

The most precise characteristic of a sign is to be differential, to be what other signs are not. Hence the most economic characterisation is given by a rule which attributes to a sign nothing but what distinguishes it from at least one other sign. And it is this rule that underlies the organisation of phonemes in all existing languages.

55. The vocalisations heard in the languages of the world are always within fairly narrow ranges among the sounds that man can produce. The child in the babbling stage is capable of producing all human sounds.

Contrary to expectation, large differences among signals cause more errors than do smaller differences. Experiments on speech perception of consonants has shown that in fact the sound distinctions received with least error are the phonological distinctive features analysed in modern phonological theory on the basis of the analysis of the language corpus.

This can be explained by the functioning of the receptors as amplifiers. The fact also begins to suggest cognitive structures as artefacts of the receptor function, as in the case of distinctive features in language.

The isolation of certain ranges of speech sounds as equivalent is a process common to the language learning of the child and to the differentiation of languages. Since any native speaker can discriminate - without being able to give reasons - what nonsense syllables could possibly be words in his language and which could not, this isolation is not arbitrary. The sound structure is in many obvious ways fitted to the means of sound perception. All levels of functioning, perception, cognition, memory, are characterised by selective information loss and transformation.

56. Stimulus-response theorists have used as their central variable the occurrence of stimuli, past and present. Gestaltists have considered the patterns of stimuli present at any one time. Neither have discussed the effect at any moment of the stimuli which might have occurred but did not, and this has been left to psychological theorists in the post-war years much influenced by information probability and game theory.

More recently, under the influence of the neurophysiology of perception, it has become clear that still a further development is required, namely one that accounts for the impressive amount of mediation that obviously goes on between stimulus and sensation, and which none of the three schools of thought has been able to consider, based as they are on the immediacy of the perceptual or cognitive act (reversible, individual).

1. Behaviourist (S-R)
2. Gestalt
3. Information
4. Mediation (in time and space)

57. This mediation refers to both neural and linguistic processes. Between stimulus and sensation, input is mediated in space and in time. In time by anticipation and postponement (of which recollection rhythm, writing, serialisation, are examples) and in space by meanings, which refer implicitly to other members of a group sharing them. Space is a mediation by others. In fact, the allotment of space - boundaries,

perimeters, habitations - is the most concrete social symbol. The two mediators - time and space - imply each other.

The model in neurophysiological research is one that accords with the known variability of perception under conditions of constant nervous activity. Its main features are :

a) Emphasis on central factors;
b) Temporal and spatial mediation : all levels of functioning, perception, memory, are characterised by selective information loss and transformation in time and space;
c) Continuity in kind between perception and cognition. Phylogenetic studies gain a relevance for the learning sciences they would not otherwise have. In fact, it is continuities such as these that make it possible to take species-specific behaviour seriously;
d) The receptor function : learning is of the nature of a reduction of the initial redundancy of connections comparable to that by which the contours of individual features are emphasised, or amplified, by a receptor. The outlines of a general theory of the encoding and storing process can be seen;
e) "Selection" refers to a mechanism in which the product under consideration is already "present" in the system prior to the arrival of the signal, and is recognised and amplified.

In fact, selection and amplification go together.

It is clear that the amplifying role not only serves to conserve energy by reducing the stimulus that is required for recognition, but it also serves a selective role in approximation - by making matching less required.

Jerne has suggested that in the history of biology "selection" theories have consistently replaced "instruction" theories. Perhaps even learning is not learning ! Either an idea is already present, then we don't need to learn it, or it is not present, in which case we couldn't recognise it. Learning is reminding, recognition.

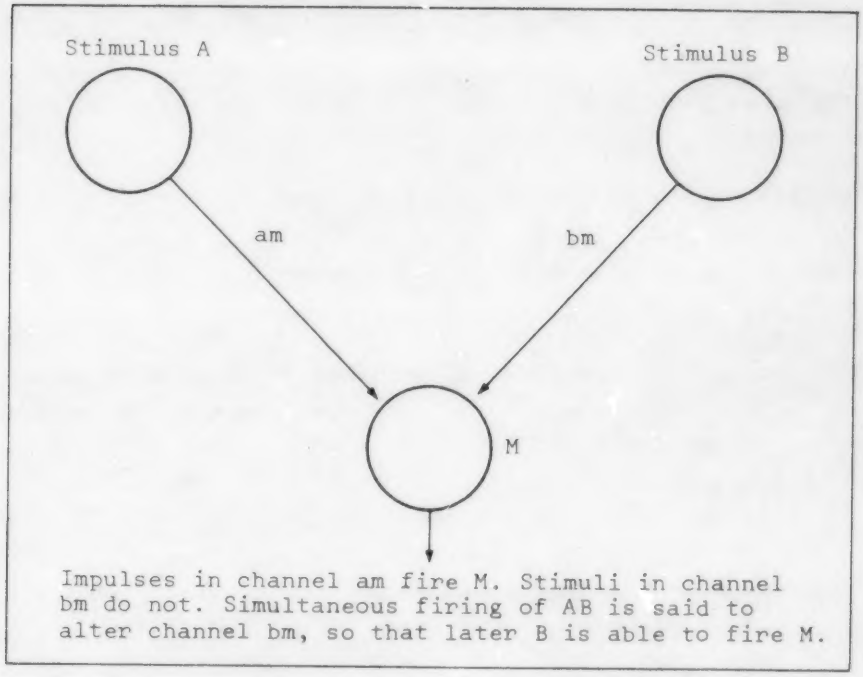
SELECTION AND DISPLACEMENT

58. The input-output model of neural activity has in the past led to underestimating the importance of inhibition. Inhibition takes an even more predominating role in view of :

1) the constant activity of the neural systems and the importance of selection;
2) the function of receptors as amplifiers;
3) a technical difficulty in S-R theory.

59. Whatever process operates in learning, it seems likely that it involves the choice between two or more possibilities. It is usually assumed that this choice is made by some form of facilitation in the pathway that has been excited. But if the actions are initially equally probable, then the probability that one of them will occur can be increased by inhibiting the other. At least a part of training, even in apparently simple conditioning, consists of learning what not to do. It is easy to imagine cellular mechanisms which are active in the course of learning to reduce the probability of subsequent use of pathways not used on the learning occasions. Indeed, the advantages of a theory of this type over what has been the conventional wisdom during much of the history of modern physiology are many. Among them is that it avoids a difficulty in theories that imagine learning by facilitation which presuppose certain cellular behaviour for which no evidence at all has been found (Burns, 1958). In such theories activity of synapses on one part of the cell is supposed to produce facilitation of synapses elsewhere on the same cell. No physiological basis for this remote effect has ever been suggested.

60. That learning occurs by elimination of the unused pathways has many attractions, in accordance with our remarks on reception and encoding processes. It becomes clear that learning is of the nature of a reduction of the initial redundancy of connections, comparable to that by which the contour of individual features is emphasised by a receptor. The outlines of a general theory of the encoding and storing process can be seen. There is no requirement for any model of right reception or pattern matching. This is another reason for rejecting the explanation that what you find organisms doing is an adaptation



Impulses in channel am fire M. Stimuli in channel bm do not. Simultaneous firing of AB is said to alter channel bm, so that later B is able to fire M.

(and that therefore learning is of this conditioning, task-adaptation type). For once the implications are explored and updated, it is theoretically more than is needed. On the contrary, organisms may continue to do those things that they are not forcednto stop doing.

Sensory systems are not built to receive either bursts or barrages of stimuli or pure stimuli, but must have built-in predilections for certain species-specific patterns.

61. When one walks around wearing wedge prims that twist the images received by the eyes, the felt orientation of the head (or the eyes) relative to the body is changed. When the visual field is inverted one adapts by coming to feel the body and world is upright, but the head feels inverted. This appears to indicate that proprioception is labile.

In a tradition of questions going back to Helmholz, we can ask what the South Sea Island spearfishers who aim from above water actually see. How does the vision of one of these fishermen whose vision is apparently corrected for Snell's diffraction law differ from other members of his community ?

62. Considerations similar to those on the strain induced by psychological experiment might suggest that there is a distinction to be made between the inducing of large errors such as are caused by prisms which necessitate adaptation and small ones (such as are caused in experimental strain) close to the threshold of normal perception, which induce reliance on cues, or performative rules common to crafts and skills.

63. The distinction is, then, between grouping objects into similarity sets immediately recognised or on the basis of criteria : "similar with respect to what ?" Uncertainty in reception may be defined as the degree to which the neighbourhood of the signal is crowded. The mechanisms for attaching words to referents are such as to decrease ambiguity greatly. They are designed precisely to make verdicts less equivocal. Klüver's monograph on equivalence of stimuli indicates the degree to which equivalence grouping is generally subject to learning.

Section IV

PHYLOGENETIC LEARNING

64. The idea that perception and cognition are formally identical, which we have just discussed, has consequences, and among them is that phylogenetic studies gain a relevance they do not otherwise have. How are the abilities of the individual related to his development and to his species ? Indeed, developments in psychology and neurophysiology are leading towards an experimental, phylogenetic study of neonate and gregarious behaviour and the transition to speech. Many behaviourists have explicitly renounced interest in those aspects of behaviour that are specific to one species and confine themselves by programme to what is universal to the behaviour of all organisms. This has made it difficult to recognise the connection between the behavioural repertoire of a species and its biology. It has also made questions of biological forms, their differentiation, growth and stability, hard to study, for behaviour that is related functionally to antecedent and subsequent (consequent) events by the environment does not appear species-specific. Phylogenetic studies of behaviour appear superfluous. But it is hard to imagine an account of form recognition in the absence of an account of the maintenance of forms.

VICARIOUS SELECTION

65. Biological studies must ultimately be studies of the irreversible chronicle of living forms and their articulation that goes under the name of phylogeny. The relation of phylogeny to ontogeny lies first of all in the fact that natural selection is not of adult traits of the species, but of its whole developmental path, its life cycle or ontogeny as a whole. For this reason, the somatic variations not directly related to reproduction and that survive reproduction,

selected variations that are typical of gregarious species and the rearing of the young, are of special interest. We tend to forget that from the point of view of selection, the species is both spatial and temporal, includes gregarious behaviour where appropriate, and pertains to the entire developmental path : that is to say, a species is not an individual passing through stages of growth, or the collection of adult members.

Order in living organisms is introduced not beforehand, by preconceived design, but after the fact - by a process akin to editing. We are the products of editing rather than of authorship.

66. Biologically, evolution is not of adaptations but of adaptability. Selection pressures from an environment will produce evolutionary changes only when the stock is malleable and can respond to the pressures. Systems must be able to respond to experience and to fix it in some way if they are to be changed by it.

"Learning to learn", accelerating adaptation, speeding auto- and hetero-catalysis is the great invention of the life stuff. This is the epigenetic mode. It allows living organisms to respond even more rapidly and adaptively to the environmental challenge, similarly it enables mindful organisms to meet their environmental problems with greater skill or speed. Epigenesis was enhanced by increased gene mutability, by the development of chromosomes and sex assortment, by adaptive changes in individual characteristics.

There is a common logic to phylogenetic and cross-cultural research. The neglect of species-specific behaviour was the weak link in the behaviourist (S-R) programme, and this neglect is tied to a neglect of developmental problems. Waddington's work suggests that, more than being linked, the two neglects are one and the same. Similar problems of differentiation underlie cross-cultural studies.

67. The environment operates upon a system at all levels, differentially selecting for survival particular genes or gene arrays, cells and cell aggregates, organs and organ systems and individuals and groups of various sizes. The environment operates not so much on the finished product as on the formative processes.

"As naturalists knowing the real facts of evolution, we are bound to consider the achievements of any intellectual

apparatus just like any other organic function - as something formed phylogenetically that owes its specific characteristics to the confrontations between the organism and the environment... And even if we are not interested in the actual process of knowledge, but solely in its 'objective' and extra-subjective bearings, we are bound to study the theory of cognition as a particular instance of the science of biological systems".
(K. Lorenz, 1965)

68. Traits transmitted from generation to generation by teaching and imitation - learned behaviour, culture - have a comparable status with genetic inheritance as a basis for natural selection. Indeed, it is often difficult to tell with which type of inheritance one is dealing - genetic or cultural. In socially organised organisms, services to the society can represent a great and continuing advantage quite apart from the act of reproduction. Worker bees are a fine example. How have they developed their extraordinary patterns of behaviour - the hive-building, the search patterns, the "language", the swarming behaviour - though the animals engaged in all these activities are sterile females? Quite clearly in this instance the hive of bees represents an organism of higher order than the individual bee. Natural selection operates on the society of bees, in competition with other bee societies and other types of animals. The germinal material in the queen and drones represents the hive as a whole and survives or fails depending on hive effectiveness based most of all on the performance of the sterile worker bees. Once the conditions of mutual advantage are established, the systematic relationship is irrelevant.

69. All animals ultimately depend for their food either on other animals or on plants. All animal populations are therefore faced with the problem of leaving enough of their food crop alive and uneaten so that it can reproduce and grow again in later years. The vast majority of animals have evolved devices by which they can escape the danger of eating their offspring out of a living. Animals are found to regulate their numbers by some other means that do not involve direct competition of individuals for food.

Men and women in human societies, individuals who may never take part in reproduction or who have passed the reproductive period, can perform services that represent obvious advantages to their society

as a whole, and hence to its reproductive members, though not directly to themselves. Here is a mechanism, such as is sometimes denied, for the selection of characters who themselves do not reproduce (and who themselves do not gain advantage from them). In human societies, of course, this mutual advantage is never completedly established.

70. In this sense, is not all selection vicarious ? The germ plasm as the bearer of heredity and ultimately, therefore, of evolution, ordinarily takes no part in this struggle for existence. Indeed, it is elaborately protected from all the eventualities that compose that struggle. It is represented in that struggle by the "body" of cells that engages in the competition for survival. Clearly, there is no great gap in principle between this dependence of the germ plasms on what is called its own soma in the struggle for survival and extending that dependence to another soma, whether of the same species or perhaps of a very different species.

It is possible to suggest how the organism might inherit a reactivity to the environment that would possess adaptive value. The further question of how the structure itself could be directly inherited without use has not received a satisfactory answer (for example, the so-called "Baldwin effect"). Some structures are both stimulated into existence by mechanical factors and present in the embryo before mechanical factors could possibly have operated. In the human foetus, for example, the soles of the feet are already thickened.

71. Waddington has made experiments to show that if you take a population of animals and subject them to a stress, some of them will respond by some sort of phenotypic modification. Such a modification is what is usually referred to as "an acquired characteristic". If in the next generation the stress does not occur, the alteration does not happen either. The acquired characteristics are <u>not</u> inherited. However, the <u>capacity</u> to acquire the character - to respond to the stress in this particular way - is inherited. After some generations, the phenotypic alteration produced by the stress is assimilated by the genotype.

Waddington has argued that it is the developmental processes themselves that are the objects of selection and that these cases should be interpreted in terms of a progressive selection of reactivity to a particular stimulus, until ultimately the reaction fires off

without any provocation - that is, a particular course of development ensues. By selecting those individuals that react, organisms are produced that respond without the stimulus.

72. A considerable body of evidence supports the view (Thorpe) that in regard to both learned and innate behaviour patterns the organism is to be regarded as "searching" largely for cues and stimuli, "consummatory" situations in fact, rather than for the release of consummatory acts. The "pool" of the behaviour is not solely or primarily the discharge of a specific motor mechanism but the achievement of a specific sensory stimulation.

Moreover, we must remember that the animal perceives its own consummatory acts primarily through its own introceptors and proprioceptors, and that in the majority of cases at least it is again a special pattern of sensory stimulation, a re-afference, which is the effective reward and not simply the general level of well-being. Stimuli are sought and not only received.

Only birds, and among mammals only men, have the ability to reproduce sounds - in other words, they possess acoustic-vocal reflexes of a specific kind. In these animals direct connections exist between the acoustic areas and the part of the motor area concerned with vocalisation.

73. Two phenomena characteristic of living systems are the power to learn and the power to reproduce themselves. These properties, different as they appear, are intimately related to one another.

The ability of the nerve terminals to grow and recognise with more or less precision their final contacts are processes of embryonic development and genetically programmed, but at a point the "ability" is labile. A further admittedly speculative but suggestive connection between learning (memory) and genetic transmission lies in the study of chemical messengers and the high emotional content of hormonal activity. A purely nervous mechanism may be capable of affective tone and of learning, but in the study of this aspect of mental activity, hormonal transmission may play an important part. In the theories of Freud, the memory - the storage function of the nervous system - and the activities of sex are both present.

Section V

PRODUCTS, PROCESSES AND RESIDUES

74. In an earlier section we discussed the attempts to infer living cognitive processes from the formal study of cultural products, such as myth, ritual and social life. The mind of the language user is neither identical with the structure of his language nor independent of the structure. In the present state of knowledge, the problem is largely methodological.

The two problems may, in fact, be answers to each other : how do laws governing skill produce the corpus of acceptable products of that skill ? To begin to answer that question requires at least that learning be formulated not in terms of experiments or isolated tasks but in terms of the - largely tacit - transmission of skills, habits, knowledge and belief systems that constitutes culture. For the culture is not in the forms but in the form-maintaining skills.

75. The argument so far makes it possible to ask a new, and we believe central, question : not how do children acquire linguistic (or other) competence, not what can we learn from linguistic structures about their acquisition, but : what accounts for the stability with which children learn language and other bodies of skill ?

All children learn to speak. What accounts for the stability with which language is acquired ? If every child in a way that is relatively independent of ability reinvents language, then language must lend itself to this. No child is ever required to reconstruct his language from scratch, and no child can. The processes in question must be such as to be performable by quite ordinary people, for even moderate genius is in short supply. What are the constraints on the codes that we can learn to compile ? What must a language be that we may learn to speak it ? Furthermore,the mechanisms of acquisition, compilation, transmission, deployment, must also be those by which language has evolved.

76. What must these mechanisms be like; what rules are obeyed ?

a) They must be stable. Two kinds of rules are possible for following a path from A to B to C.

One kind tells you the orientation from A to B followed by the orientation from B to C. The other kind puts you on the path ABC and warns you when you deviate. The two kinds of rule differ in the following respect : in the first case, if you deviate from the path you are lost : the rule will not get you back. In the second, if you deviate from the path you can find your way back on it by following the rule; in fact, that is all the rule is for. The second kind of rule is stable, the first is not. That anyone following any path will deviate from it is, of course, highly probable. Structural stability is central to morphogenesis, since in life something always goes wrong and living forms must be such as are unaffected by relatively minor though constant perturbations.

b) They are mechanisms of retrieval, not of generation : they need only tell you when something is wrong, not how to be right. What are required are skills - of discernment and selection, not knowledge. Therefore, the rules are likely to be of a negative form, and because their function is retrieval, they are likely to operate in memory.

c) They are sub-optimal : cognitive activity as we have here described it is less a question of getting something right than of hedging against failure and risk. Sub-optimal rules are those that say not what is "best" but only what is "good enough" (what answers to a criterion and what does not). They are rules of uncertainty reduction and loss-cutting.

d) They are of a yes/no (digital) form. Judgments made must be choices, in other words discrete. Furthermore, yes-or-no rules

provide the empty perceptual space required for immediate recognition and for immediate correction should a deviation occur.

The continuity typical of optimal forms (forms as recognised) must be the result or residue of the composition of reiterated discrete choices (forms as maintained). We do not recognise forms; we maintain them.

77. The rules of generative grammar as described by linguists following on Chomsky's formulations are such as to derive, by means of algebraic transformations, the current natural language from strings of primitive nominal phrases. Now it happens that these transformational rules are not stable. The rules governing living processes such as these, however, must necessarily be stable for, if they were not, we should have no language at all. In fact, Chomsky contends that they are biologically innate. Our discussion points to a great number and variety of research problems, but a starting point is certainly to articulate the requirement for stability in generative grammar. Until now the requirement has not even been posed and it is likely that introducing it will require reworking a good deal of the accumulated analysis.

78. The simulation of human problem-solving skills achieved by computer programmes may be adequate as far as performance is concerned and yet in no way reflect the underlying human abilities engaged in the particular example. In an evolving system, a limited partial capability should grow almost continuously into a more powerful capability. But most computer programmes have an all-or-none character : disable one subroutine and a programme will probably do nothing useful. Underlying human competence can obviously not be of this unstable type, and the general information processes that are considered typical of human cognitive activity - serial order and a separate short-term-memory - probably have a stabilising function.

The Serbo-Croatian illiterate oral epic poets studied in the thirties by Millman Parry, produced their epic poems by stringing formulae consisting of parts or wholes of a traditional metric (decasyllabic) line by integrative mnemonic process that are surely very complex. Furthermore, they recited these poems at a very fast clip and the same story told twice was never the same. Clearly, they did

not remember by rote anything but the repertoire of formulae. These epic singers were not, in general, any more than similar practitioners of other transmitted arts, Persian rugmakers or raga players, remarkable people, though a rare genius might occasionally arise. In order to find out how these crafts are performed we must realise that they cannot require highly exceptional powers, though they are certain to require commensurately arduous and prolonged training. It is less important (and perhaps quite beyond him) for such a practitioner to know <u>how</u> to make things go right than it is for him to recognise when they have gone wrong.

79. What results from the performance of a skill as a bundling (like a phoneme ?) of separate sub-optimal choices is that the performance of a skill does not need to follow a model in the way that is characteristic of optimalisation. Instead, the resulting product is randomly projected into a sequence or a serial, temporal, order of yes-no decisions, and in turn the intuition that something is wrong appears less "intuitive" : when we sense that something is wrong we are not attending (though we appear to be) to the product as a whole, but only to one of the multi-dimensional choices that can be analysed serially (note that these choices are not "aggregated" since they are in different dimensions, i.e. not about the same criterion). This permits the skilled performer to react immediately, because for him only one thing at a time normally goes wrong.

80. We have sketched a method of studying skill as a composition of suboptimal choices along relatively independent dimensions. What we recognise immediately is a composite of less complex "subrecognitions". Skill consists in implicitly separating out these "subrecognitions". and recognising when something goes wrong in the simpler dimension; putting it right is then close to immediate. Not having the skill means that something is recognised as being wrong only when in fact a great deal has already gone wrong and it is too late for a simple remedy. Skill resembles inverse problem-solving in that one of the first rules for solving a problem is to break it up into do-able subproblems that are sufficiently independent of each other to be tackled one at a time. The fact is that <u>we can only think of one thing at a time</u>, and skills are <u>mixed</u>.

Not only must such mechanisms account for the stable recurrence of effective learning and skill, but they must also account for this stability in the face of what may be strong enticements to change.

81. To ask about the stability of skills means to ask about the stability of cultures. It is likely that socialisation to different cultures, subcultures and social classes consists in increased control of first-cue searching in unfamiliar situations where immediate recognition is not possible. Various ground rules for this searching in different groups might be the permitted ("perceived") margin of vagueness or uncertainty : that is, what in each group constitutes a conceptual space sufficiently isolated to be recognised immediately.

a) Spatial mediation
There may be a more or less crowded conceptual space within which recognition can operate. Different degrees of tolerance of ambiguity imply different restrictions on the foundation of differentiated equivalence classes, constraints on categorisation and exchange.

b) Temporal mediation
There may be degrees of sub-optimality invoked in the presence of uncertainty. Different margins of error, different reliance on predictability as reflected in hesitation and anticipation phenomena in behaviour imply differing constraints on planning, expectancy, investment, risk-taking.

It is typical of psychological experiments that the culturally conditioned immediate recognition of forms - and the form-maintaining skills that underlie it - are made difficult, and the subject is forced as in many more lifelike situations to resort to criteria and explicit rules. Recourse to rules is evidently a sign of impaired cultural transmission.

82. Bernstein's two codes - restricted and elaborated - are in this sense sociolinguistic gating mechanisms that underline the role of speech in the regulations of class behaviour and transmission (learning). The codes are distinguished one from the other by tolerance for different degrees of uncertainty (predictability and difference).

The study of these codes makes it clear that the problems of socialisation are not ones of the acquisition of habit or knowledge, nor of spheres of influence in the development of a child, but of the structures and functions of transmission of what we have been calling form-maintaining skill - whether the forms be perceptual, linguistic, or semantic.

83. The restricted code is closer to oral transmission and implicit rules; since the rules are nowhere recorded, an important function of messages is to reinforce the code. In written transmission the code no longer requires reinforcement since it can if necessary be part of the message, as in speech characterised by an elaborated code. Of course, the "metalanguage" (the explicit reference to the code) in elaborately coded speech is not actually metalanguage, but an illusory explicitness similarly found in school transmission and in the language of science, so consistently held at arm's length from scientific practice.

84. School "codes", as Bernstein reminds us, are by definition "elaborated codes" - and there is a contradiction in the notion of a school employing restricted codes - though Jensen has seemed to advocate such schools for US blacks. It is a fact that we do not know as much as ethnologists could tell us about "restricted" oral transmission, or in general about transmission in illiterate societies - were they to consider the topic worth studying.

85. The task of characterising social classes cultures and subcultures begins with that of characterising their transmission between generations. Transmission has been neglected in the very fields most concerned with ethnological and cross-cultural questions. Particularly the transition, in the history of cultures, from oral to written transmission is virtually unexplored, though the boundary between oral and written defines the discipline of ethnology itself.

86. Cognitive activity in general is more circumspect than we imagine - and its aims are more often sub-optimal than optimal : not a question of getting something right, but of hedging against failure or risk, of preferences for some forms of failure rather than others.

A is a good loser when, holding good cards, he makes a fatal error, but a bad loser when he is dealt cards with which it is impossible to win. With B it is the other way round; he cheerfully resigns

himself to defeat if his hand is poor, but becomes furious if defeat is his own fault. The good loser expresses his relief at not having lost the other way. Reaction to change appears to be a strategy as well for dealing with the consequences of error. Some prefer the risk of reacting and possibly being wrong to the risk of not reacting and possibly being wrong, and vice versa.

87. Bartlett's text on remembering says that members of preliterate cultures learn by rote but that is logically impossible for, if they did, then sooner or later there would be nothing left to remember. The purpose of mnemonic methods must be to be able to find the thread again if you lose it. Where a written text exists, rote or "verbatim" memorisation is ideal since the point at which you lose the thread acts as an index for looking it up again. But where there is no text, if you learn by heart, linearly, and lose the thread, then you have lost it. Mnemonic methods must permit the text to be reconstructed. For peoples without writing, memory must be more architectural than linear.

In a culture without writing, very small changes are unlikely to be noticed since there is no point of comparison.

Mnemonic techniques are in accord with the mode of transmission. In a culture without writing, very small changes are likely to go unnoticed since there is no point of comparison. But where there is a written, fixed text, a criterion of <u>precision</u> comes into play - comes into being, perhaps, for the first time.

The role of imitation in maintaining cultural forms - aside from being hardly defined - has been exaggerated. For imitation cannot account for changes in a particular direction. Skills shape and are stabilised by the forms they maintain, the representative situations in which they are exercised.

Recently there has been a new and growing concern - stimulated largely by ethnic and social class differences in intellectual performance - with the interpretation of psychological experiments, particularly inferences concerning underlying skills or capacities. A new understanding of skills as "culture-specific" calls for a vast enrichment of both theory and experimentation.

88. Succinctly, some features of the proposed research design are as follows :

i) Sensory modes and cognition are looked at together, making it possible to combine a socio-cultural hypothesis and a neurophysiological one : form recognition depends on form-maintaining skills. The apparatus required for immediate recognition must be highly selective.

ii) Products - such as bodies of language, skill, knowledge or belief - are understood not as acquisitions but as adaptive residues of particular form-maintaining skills. There follows from this reformulation that skills are "culture-specific", that the locus of these problems and many others is in the mode of intergenerational transmission (repetition, reproduction).

iii) An approach is sketched out for analysing those aspects of learning most relevant to educational, especially pre-school, problems : skill, subliminal transmission, observer and experimenter effects, discontinuities between the learner as receiver and as sender.

iv) Skilled activities and sensory modes have, like language, a kind of grammar, or system of rules. These rules must be such that the resulting structures can have evolved by small self-adapting steps. This requirement has implications for the study of these and other structures.

v) What must there rules be like ? The question of stable rules and stabilisation is raised and given a precise formulation as a first step in a "selection" as opposed to an "instruction" theory of learning.

vi) We do not study isolated skills but the bodies of skill of which they are part. And we ask two fundamental questions :
   a) what is acquired with the acquisition of a body of skill, for example a first language ? and
   b) what must bodies of skill be like that they may be learned ?

REFERENCES

Arrow, K.J., "The Economic Implications of Learning by Doing", Revue of Economic Studies, June, 1962, pp. 155-173.

Bernstein, B., Class, Codes and Control I : Theoretical Studies towards a Sociology of Language (London, 1971).

Bruner, J.S., Goodnow, J.J., and Austin, G.A., A Study of Thinking (New York, 1956).

Burns, B.D., The Mammalian Cerebral Cortex (London, 1958).

Campbell, D.T., "Methodological Suggestions from a Comparative Psychology of Knowledge Processes", Inquiry 2 (1959), pp. 152-182.

Chomsky, N., Aspects of a Theory of Syntax (Cambridge, Mass., 1965).

Jakobson, R., Halle, M., Fundamentals of Language (The Hague, 1956).

Jerne, N.K., "Antibodies and Learning : Selection versus Instruction" in : G. Quarton, ed., The Neurosciences I (New York, 1967).

Klüver, H., Behavior Mechanisms in Monkeys (Chicago, 1933).

Kuhn, T., The Structure of Scientific Revolutions (Chicago, 1962).

Lashley, K.S., "The Problem of Serial Order in Behavior", in : L.A. Jeffres, ed., Cerebral Mechanisms in Behavior (New York, 1951). 1951).

Lettvin, J.Y., Maturana, H.R., McCulloch, W.S., and Pitts, W.H., "What the frog's eye tells the frog's brain", Proc. Inst. Radio Engineers, 47 (1959) 1940-51.

Levi-Strauss, C., La Pensée Sauvage (Paris, 1962).

Lorenz, K., Studies in Animal and Human Behavior, I (New York, 1969).

Luria, A., Human Brain and Psychological Processes (New York, 1966).

Mauss, M., "Les Techniques du Corps", Journal de Psychologie, 32 (1935) pp. 271-93.

Piagetian Inventories ("Science and Pedagogy", CERI/OECD, Paris), to appear.

Rosenthal, R., Pygmalion in the Classroom (New York, 1970).

Thom, R., Stabilité Structurelle et Morphogénèse (New York, 1972).

Thompson, d'Arcy, W., On Growth and Form (Cambridge University Press, 1966).

Waddington, C.H., The Strategy of the Genes (London, 1957).

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